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Notes and short scientific papers relating to the botany of the region are welcomed and will be published to the extent that the size of the Journal allows.

Authors will receive six gratuitous copies of the issue in which their papers appear. Separate reprints, if ordered in advance, will be furnished at cost.

CASTANEA

The Journal
of the
Southern Appalachian Botanical Club

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Distribution Notes on Some Grasses in North Carolina

STEVE G. BOYCE and R. K. GODFREY

The distribution records for the grasses herein reported were contributed by members of the staffs of three North Carolina institutions, namely, Duke University, the University of North Carolina, and North Carolina State College. Previous records are based upon observations of available literature and an examination of specimens in the herbaria of the above-mentioned institutions.

The authors wish to express here their appreciation for assistance rendered them by Prof. H. L. Blomquist of Duke University, Dr. A. E. Radford of the University of North Carolina, and Prof. B. W. Wells and Dr. William B. Fox of North Carolina State College. We wish also to express our thanks to the respective curators of the herbaria of Duke University and of the University of North Carolina.

In citing specimens the following abbreviations are employed to designate the herbaria in which the specimens are deposited: (D)—Duke University; (UNC)—the University of North Carolina; (NCS)—North Carolina State College.

NEW RECORDS FOR NORTH CAROLINA

AGROPYRON TRACHYCAULUM (Link) Malte. CLAY COUNTY: pine barren on mountain slope, Doe Knob, along Buck Creek, Aug. 2, 1951, *Godfrey, Fox,* & *O'Connell* 51686 (D, NCS).

An extension of range southward to southwestern North Carolina from West Virginia.

MUHLENBERGIA GLOMERATA (Willd.) Trin. CLAY CO.: pine barren on the backside of Chunky Gal, above Buck Creek, Aug. 24, 1951, *Godfrey* 52063 (D, NCS).

An extension of range southward to southwestern North Carolina from West Virginia and Virginia.

SPOROBOLUS HETEROLEPIS (A. Gray) A. Gray. CLAY CO.: pine barren on the backside of Chunky Gal, above Buck Creek, Aug. 24, 1951, *Godfrey* 52067 (D, NCS).

Previously unrecorded for the area to the south of the Ohio River and to the east of the Mississippi River.

The three species above are grouped together because all were found to occur as abundant grasses in a pitch-pine barren community on a rocky mountain slope in southwestern North Carolina, the exposed rocks of the area being largely olivine. The general known range of distribution of each of the three species is to the west and/or to the north and this locality represents an isolated, considerably disjunct station for each.*

BROMUS CILIATUS L. ASHE CO.: wet soil, bluff near waterfall, Bluff Mountain, alt. 5073 ft., Aug. 28, 1950, *Anderson* & *Jones* 2482 (D).

Chase, in Hitchcock's Manual (1950), gives the range of occurrence of this species as Newfoundland to Washington, etc., south to the mountains of Tennessee, but with no indication that it occurs in North Carolina. Fernald, in Gray's Manual (1950), however, specifically refers to its occurrence at "Roan Mountain, N. C." We have no knowledge of the basis for Fernald's report and since the North Carolina-Tennessee boundary crosses the summit of Roan Mountain there may be some question as to which state the collection was made in. We, therefore, cite this collection as confirmation of its expected occurrence in this state.

LEERSIA LENTICULARIS Michx. JONES CO.: marly loam in hardwood forest on Island Creek, Oct. 7, 1951, *Radford* 5929 (D, UNC).

According to Blomquist (1948), this species was reported by I. F. Lewis (1917) from Shackleford Banks, Carteret County. Lewis states that specimens of practically all of the plants involved in his study were sent to Dr. John K. Small, of the New York Botanical Garden, who assisted in their determinations. Dr. Blomquist, how-

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*The junior author's 1951 summer field work in the Highlands region of North Carolina, where these three interesting additions were made to the knowledge of our grass flora, was made possible by a grant from the Colonel and Mrs. John S. Sewell Fund administered by the Highlands Biological Station.

ever, was unable to locate a Lewis specimen of this species. We have checked Lewis' paper and we have not found a reference to *Leersia lenticularis* (or to a synonymous name). Chase in Hitchcock's Manual (1950), although indicating a general range for the species which includes North Carolina, has no mapped locality shown for the state. We are, therefore, citing Radford's collection and consider it the first authentic record of occurrence for the species in North Carolina.

PANICUM GYMNOCARPON Ell. PITT CO.: growing in water along an abandoned logging road on the floodplain of the Tar River, near the bridge at Greenville, Sept 23, 1950, *Boyce, Fox* & *Godfrey* 1668 (D, NCS).

Chase, in Hitchcock's Manual (1950), gives the distribution of this species as banks of streams and lakes from South Carolina to Florida, Arkansas and Texas. This collection represents an extension or range northward from South Carolina.

PASPALUM FLUITANS (Ell.) Kunth. BLADEN CO.: boggy woods, 2.6 miles n.w. of White Oak, Oct. 14, 1951, *Radford* & *Wood* 5948 (D, NCS, UNC).

Previously known from southeastern Virginia and more generally from South Carolina southward and westward, but, according to Chase in Hitchcock's Manual (1950), not hitherto known to occur in North Carolina.

TRIDENS CAROLINIANUS (Steud.) Henr. BRUNSWICK CO.: Transect no. 1, 160 m. from the ocean, in live oak forest, between Long Beach and Fort Caswell, Oct. 14, 1950, *Boyce, Wells and Shunk* 1567 (D, NSC).

Chase, in Hitchcock's Manual (1950), reports this species as occurring in sandy woods of the coastal plain from South Carolina to Florida and Louisiana. The above collection represents an extension or range northward from South Carolina.

SIGNIFICANT ADDITIONAL RECORDS FOR SPECIES PREVIOUSLY KNOWN TO OCCUR WITHIN THE STATE

AMPHICARPUM PURSHII Kunth. COLUMBUS CO.: abundant in a corn patch on a savanna, between Old Dock and Nakina, Sept. 1, 1949, *Godfrey* & *Beaman* 50062 (NCS); PITT CO.: abandoned field, 5 miles n. of Grifton, Sept. 23, 1950, *Boyce, Fox* & *Godfrey* 1667 (NCS); PENDER CO.: roadside in Holly Shelter Bay, near Back Island, Oct. 7, 1950, *Boyce* 1511 (NCS); ONSLOW CO.: along logging road, low

ground, about 5 miles n.w. of Richlands, Sept. 1, 1948, *Blomquist* 14354 (D).

Blomquist (1948) reports the occurrence of this species only in Brunswick and New Hanover Counties. These collections indicate a more widespread distribution to the northward and westward in the coastal plain of the state.

ANDROPOGON LITTORALIS Nash. ONSLOW CO.: abundant on fore dunes, s. of New River Inlet, Sept. 14, 1950, *Boyce* 1497 (NCS); BRUNSWICK CO.: on high dunes with *Uniola paniculata* L., s.w. end of Long Beach, Oct. 28, 1950, *Boyce* & *Godfrey* 1590 (NCS).

The only previously recorded station for the state is on Bogue Banks, near Fort Macon, Carteret County (Blomquist, 1948).

ARISTIDA AFFINIS (Schult.) Kunth. WAYNE CO.: sandy pine woods at Seven Springs, Sept. 23, 1950, *Boyce, Fox,* & *Godfrey* 1660 (NCS).

According to Blomquist (1948), this plant is rare, occurring only in the coastal plain near the coast. There are specimens in the Duke herbarium from Halifax and Brunswick Counties. The station at which this collection was made is approximately equidistant from those two widely separated coastal plain counties.

DESCHAMPSIA FLEXUOSA (L.) Trin. DURHAM CO.: dry road bank just below Michie Dam, May 20, 1950, *Batson* (D); HARNETT CO.: on north-facing granite outcrop at Raven Rocks, 5 miles n. of Namers, Nov. 7, 1950, *Boyce et al* 1605 (D, NCS).

Previously known only from higher altitudes in the western part of the state (Blomquist, 1948); these collections are from stations in the outer piedmont and inner coastal plain respectively.

ERIANTHUS STRICTUS Baldw. ANSON CO.: the dominant on abandoned rice field at Brown Creek, 3 miles s. of Ansonville, Sept 18, 1950, *Boyce* 1501 (NCS).

Although not infrequent in marshes and swampy woods of the coastal plain, only one previously known piedmont station is recorded, namely Forsyth County (Blomquist, 1948).

HYDROCHLOA CAROLINIENSIS Beauv. BRUNSWICK CO.: near transect No. 1, in water of lagoon, 75 m. from sea, matted, with tops projecting above water, between Long Beach and Fort Caswell, Aug. 2, 1950, *Boyce* 1277 (D, NCS).

Previous collections of this species (Blomquist, 1948) were made in Tyrrell and Wayne Counties. This collection represents a record from a new location at a considerable distance from the other two.

PASPALUM BIFIDUM (Bertol.) Nash. BRUNSWICK CO.: transect No. 1, 200 m. from the ocean in live oak forest, between Long Beach and Fort Caswell, Oct. 14, 1950, *Boyce, Wells & Shunk* 1558 (NCS); behind high dunes in live oak forest at s.w. end of Long Beach, Oct. 28, 1950, *Boyce & Godfrey* 1595 (NSC).

The first authentic record of occurrence of this grass in North Carolina was reported by Fox, Godfrey and Blomquist (1950) from Moore County. These two additional locations are in the outermost coastal plain whereas the other was in the innermost portion of the coastal plain.

UNIOLA SESSILIFLORA Poir. BLADEN CO.: roadside, bank of Cape Fear River, about 0.5 mile above ferry, n.e. of Corners, Aug. 28, 1948, *Fox & Whitford* 1854 (NCS).

A third locality for a plant hitherto known from Bertie and Brunswick Counties (Blomquist, 1948).

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The Juglandaceae and Corylaceae of Tennessee*

James W. Hardin

Introduction

Tennessee, located in the heart of the Deciduous Forest of North America, has some seventy-six genera of native or naturalized trees. Of the species of trees included in the Juglandaceae and Corylaceae, many are abundant, and some reach dominance within the communities to which they belong. The hickory shares dominance with the oak in a considerable part of the forest area of the state. Birch is found often as a dominant or co-dominant in many localities in Tennessee. The yellow birch, with hemlock and rhododendron, forms a characteristic community in many parts of the Great Smoky Mountains.

The Juglandaceae and Corylaceae have presented botanists with a number of problems. In many cases the trees of *Carya* (*Hicoria*) are considered difficult to identify. The taxonomy of *Alnus* and *Betula* has been confused for many years. It is the purpose of this paper to present keys and a synopsis which embody the diagnostic characteristics of the species and varieties included in these two families in a form which may be used for field identification or the identification of herbarium specimens.

This taxonomic study has been made specifically in regard to the Tennessee populations of the two families. In connection with this study, the geographic and habitat distributions within the state have been recorded. It should be understood that not all difficulties in the taxonomy of these groups have been resolved. Long and careful field study of many species is needed for a complete understanding of these populations in Tennessee.

The Family Juglandaceae

Containing two genera and thirteen species in Tennessee, this family is considered of great commercial importance for both timber and fruit.

Aments of staminate flowers simple; husk of the fruit indehiscent; nut sculptured; pith chambered; leaves

*Contribution from the Botanical Laboratory, The University of Tennessee, N. Ser. No. 135. A more detailed account including descriptions and distribution maps is contained in a thesis presented to the Graduate School of the University of Tennessee for the degree of Master of Science, 1951. The advice of Dr. R. E. Shanks and Dr. A. J. Sharp is gratefully acknowledged.

with odor of green walnuts when crushed ..... 1. Juglans

Aments of staminate flowers branched; husk of the fruit 4-valved; nut not sculptured; pith homogeneous; leaves without walnut odor ..... 2. Carya

1. JUGLANS L. (*Wallia* Alef.)

Trees 50-100 feet high, with round or irregular crown.

Leaflets 7-17, oblong-lanceolate, rounded at base, downy with fascicled hairs; pith brown; leaf scar surmounted by a velvety ridge; fruit ellipsoid, clammy, racemose ..... a. J. cinerea

Leaflets 11-23, ovate-lanceolate, cordate or unequal at base, minutely downy beneath with hairs solitary or in pairs; pith buff; leaf-scar notched and smooth; fruit spherical, not clammy, usually solitary or in pairs ..... b. J. nigra

a. J. CINEREA L. (*Wallia cinerea* Alef.). Butternut. Rich woods, river terraces, moist fields, in practically all regions of Tennessee with the exception of the Central Basin and parts of western Tennessee.

b. J. NIGRA L. (*Wallia nigra* Alef.). Black Walnut. Rich woods in valleys, bottomlands, as scattered field or pasture trees, in hardwood stands, or in pure stands on the edge of hardwood forests. Recorded in Tennessee from every county except Union.

2. CARYA Nutt. (*Hicoria Raf.*)

Hicoria has been spelled eight different ways (Little, 1948) beginning in 1808 with Scoria which was apparently a typographical error and changed by Rafinesque to Hicorius (1817) and Hicoria (1838).

Large, aromatic, resinous trees with watery juice.

Synopsis of Diagnostic Characters

It should be of value to summarize, separately from the key, the diagnostic characteristics which have proved useful for field identification. Since more than one feature of the whole tree is usually necessary to separate the hickories, field identification is much more definite than the identification of herbarium specimens. The hickories north of Virginia have been treated in this way by Dr. Wayne E. Manning (1950).

C. aquatica: 7-13 leaflets, strongly falcate and narrow; fruit angular-flattened and usually wrinkled; bark scaly; restricted in Tennessee to the river swamps of the westernmost counties.

C. carolinae-septentrionalis: shaggy bark and special tuft of hairs on the serrations as in *C. ovata*, but the bud-scales nearly black, and the blades of the lower pairs of leaflets narrowly lanceolate to linear-lanceolate, long-acuminate; branchlets and rachis glabrous; leaflets 3-5.

C. cordiformis: 7-11 leaflets; buds bright yellow; bud-scales valvate; fruit cylindrical and usually slightly compressed; bark close and firm, sometimes slightly scaly on older trees.

C. glabra: very similar to *C. ovalis* but differs in having usually 5 leaflets (rarely 3 or 7), fruit obovoid usually with narrow stipitate base, husk indehiscent or tardily dehiscent; bark tight, ridged below but not scaly.

C. illinoensis: leaflets 9-17, strongly falcate (as opposed to rarely falcate in *C. cordiformis* with which it is likely to be confused); buds with bright yellow hairs; fruit ovoid-oblong, cylindrical, with seed sweet; bark with fine, scaly, interlacing ridges.

C. laciniosa: 7-9 leaflets; twigs only sparsely pubescent; terminal bud very large with persistent outer scales; blades of the leaflets without the subterminal tuft of hairs on the serrations; bark shaggy as in *C. ovata* but the large plates usually extending to the top branches; fruit 4-6.5 cm. long, with thick husk.

C. ovalis: typically 5-7 leaflets (sometimes only 5), glabrous, or hairy in the rare var. *mollis;* lower surface of leaflet with pale scattered glands; base of rachis usually dark red; fruit short oblong, subglobose to ellipsoid, the involucre opening freely to the base; bark usually scaly or shaggy, but smooth when young.

C. ovata: usually 5 leaflets (5-7), glabrous to slightly hairy, or pubescent in the var. *pubescens;* very similar to *C. laciniosa* with very shaggy bark, but may be readily determined by the subterminal tuft of hairs on the serrations; blades of the lower pair of leaflets ovate to to elliptic-lanceolate, acute or short-acuminate; buds dark but not black.

C. pallida: leaflets 7-9, narrow, lanceolate and long attenuate, pale on back; scattered fascicles of hairs on rachises and midribs of leaflets, but not on the surface of the leaflet proper; pale glands common on the lower surface of the leaflets; buds and fruit yellow with grandular scales; fruit the shape of *C. glabra* (but larger) or ellipsoid to globose; bark usually pale to dark gray and deeply furrowed.

C. texana: very similar to *C. pallida* and *C. ovalis*, but with rachis and twig fascicled-hairy and the backs of the blades with numerous red glands in the spring.

C. tomentosa: leaflets 7-9; twig, rachis, and lower surfaces of leaflets pubescent with separate fascicles of curly hairs; bark tight and deeply furrowed, with the appearance of walnut bark.

Bud-scales 4-6 paired, valvate; leaflets 7-17.

Buds permanently yellow-scurfy; leaflets rarely falcate ..... a. *C. cordiformis*

Buds brown to reddish-brown with yellow hairs or caducous yellow glands; leaflets strongly falcate.

Bark scaly; buds with yellow glands; fruit angular-flattened ..... b. *C. aquatica*

Bark with fine, scaly, interlacing ridges; buds with bright yellow hairs; fruit ovoid-oblong, cylindrical ..... c. *C. illinoensis*

Bud-scales 6-12, imbricated; leaflets 3-9.

Bark separating into long, shaggy plates.

Serrations of leaflets with persistent, subterminal tuft of hairs.

Blades of the lower pair of leaflets ovate to elliptic-lanceolate, acute or short-acuminate; twigs rarely smooth, coarse, with dark brown buds ..... d. *C. ovata*

Blades of the lower pair of leaflets narrowly lanceolate to linear-lanceolate, long acuminate; twigs smooth, fine, with nearly black buds ..... e. *C. cavolinae-septentrionalis*

Serrations of leaflets without subterminal tuft of hairs ..... f. *C. laciniosa*

Bark smooth or variously ridged, or scaly but not in long, gray, shaggy plates.

Twigs, petioles or leaflets (or all three) hairy with separate fascicles of hairs, leaflets 7-9.

Fascicles of hairs on rachis, frequently on twig, and on lower surface of leaflets; buds and fruit without granular yellow glands ..... g. *C. tomentosa*

Fascicles of hairs on rachis, twigs, or on midribs of leaflets beneath, but absent from the surface of the leaflets proper; buds and fruit with glands.

Twig not hairy; leaflets with numerous clear or pale yellow glands ... h. *C. pallida*
Twig hairy; leaflets with numerous red glands in the spring ..... i. *C. texana*

Twigs, petioles, or leaflets glabrous, or if hairy the hairs crowded and not in definite fascicles; leaflets 3-7.

Leaflets mostly 5 (rarely 3 or 7); fruit obovoid usually with a narrow stipitate base, husk indehiscent or tardily dehiscent; bark tight, ridged below but not scaly ..... j. *C. glabra*

Leaflets mostly 7 (occasionally 5); base of rachis usually red; fruit short-oblong, sub-globose to ellipsoid, the involucre opening freely to the base; bark scaly or shaggy on mature trees ..... k. *C. ovalis*

a. C. CORDIFORMIS (Wang.) K. Koch (*C. amara* Nutt., *Hicoria minima* Britt.). Bitternut Hickory. Moist, rich soils of woods, streambanks, and swamps. Although not the most common, this is probably the most widely distributed hickory. In Tennessee it is found in all regions, but never abundant in any locality.

b. C. AQUATICA (Michx. f.) Nutt. (*Hicoria aquatica* Britt.). Water-hickory. Deep swamps, river-bottoms and moist to wet woods. This species is restricted in Tennessee to the river-bottoms of the westernmost counties.

c. C. ILLINOENSIS (Wang.) K. Koch (*Hicoria pecan* (Marsh.) Britt., *C. pecan* Engl. & Graebn.). Pecan. Bottomlands of the Mississippi Valley. The pecan is found native on the bottomlands of West Tennessee, but has been planted widely throughout the state for the fruit; thus the locations eastward are of probably introduced trees.

d. C. OVATA (Mill.) K. Koch (*Hicoria ovata* Britt.). Shagbark Hickory. Rich woods, bottoms and slopes. Found generally distributed in all regions; often abundant in woodlots and park-like fields or permanent pastures.

Var. PUBESCENS Sarg. differs from the typical form in having the mature twigs, petioles, rachises, and often the lower surfaces of the mature leaflets strongly villous; the hairs on the leaflets in fascicles, though mixed with single or paired types. The variety is scattered

throughout the range of the species, the two forms often growing together.

e. C. CAROLINAE-SEPTENTRIONALIS (Ashe) Engl. & Graebn. (*Hicoria carolinae-septentrionalis* Ashe). Southern Shagbark. Dry limestone hills, riverbottoms and low woods. Recognized in widely scattered locations in Tennessee, and possibly more widely distributed than is shown by the records.

f. C. LACINIOSA (Michx. f.) Loud. (*Hicoria laciniosa* Sarg.). Shellbark Hickory. Rich woods and bottomlands. Not abundant, but found in all regions with the exception of the Unaka Mountains.

g. C. TOMENTOSA Nutt. (*Hicoria tomentosa* Raf., *C. alba* (L.) K. Koch, *H. alba* (L.) Britt.). Mockernut Hickory. Dry to moist woods in all regions.

h. C. PALLIDA (Ashe) Engl. & Graebn. (*Hicoria pallida* Ashe). Sand Hickory. Woods, dry stony ridges, or in sandy soil, mostly on the Cumberland Mts., e. and w. Highland Rims, and uplands of w. Tenn.; however, it is not abundant in any locality.

i. C. TEXANA Buckl. (*C. buckleyi* Durand, *C. texana* var. *arkansana* (Sarg.) Little, non *C. texana* C. DC.). Black Hickory. Dry sandy woods or rocky slopes. Three specimens from Henry and Shelby counties have been identified as this species, but its status in Tennessee is as yet uncertain.

j. C. GLABRA (Mill.) Sweet (*Hicoria glabra* Britt.). Pignut Hickory. Dry woods and slopes of poor soil, valleys along streams, throughout Tennessee in all regions but only found locally in some parts of w. Tennessee.

Var. MEGACARPA Sarg. might be present, but has not been identified in the Tennessee populations. This variety differs from the typical form by having larger leaves and fruit.

k. C. OVALIS (Wang.) Sarg. (*Hicoria ovalis* Ashe). Red Hickory. Rich woodlands and bluffs, or dry exposed hillsides. This species is generally distributed in all regions, probably growing at the greatest altitude of any species of hickory in the mountains of e. Tenn.

Var. OBCORDATA (Muhl. & Willd.) Sarg. Northern Red Hickory. This variety differs from the typical form by having the nut angled, broadly ellipsoid, cordate or subcordate at the apex; petioles, rachises, and leaflets glabrous. The variety has been found in Shelby, Fayette, Haywood, Henderson and Grainger counties.

Var. OBOVALIS Sarg. Pearnut Red Hickory. Another glabrous

form, but with the fruit obovoid. This variety has been found in Haywood county.

Var. MOLLIS Ashe. Carolina Red Hickory. This is the pubescent form of the species with the rachis and often petiole and lower surface of the leaflet densely pubescent. Although found only in Grainger county, is it possible that this variety, as well as the others, is more common in the Tennessee populations than is indicated by present collections. More extensive field observations are needed.

It will be noted that the pubescent form of this species has been referred to var. *mollis* Ashe, following Manning (1950) rather than to var. *hirsuta* (Ashe) Sarg. which is used in the Eighth Edition of Gray's Manual of Botany.

The Family Corylaceae

In most manuals or botanical references the name Betulaceae is used. Small (1933) used both the Corylaceae and Betulaceae, the former including *Carpinus*, *Ostrya*, and *Corylus*, and the latter including *Betula* and *Alnus*. Fernald (1950) used Corylaceae to include all five of these genera, the practice followed here.

These five genera include nine species of trees and shrubs in Tennessee, and constitute one of the more important families of woody dicotyledons.

For Fruiting Material

Fruit wingless, more or less enclosed in an involucre formed by the enlargement of the floral bracts.
- Pistillate flowers in aments, nut small and achene-like.
  - Fruiting bracts flat, three-lobed, foliaceous ..... 1. *Carpinus*
  - Fruiting bracts bladder-like ..... 2. *Ostrya*
- Pistillate flowers few in heads, involucre leafy, enclosing the acorn-like nut ..... 3. *Corylus*

Fruit more or less broadly winged, without an involucre.
- Bracts of the mature pistillate aments membranceous, three-lobed, deciduous with the fruit ..... 4. *Betula*
- Bracts of the mature pistillate aments thickened and woody, 3 to 5-lobed, long persistent ..... 5. *Alnus*

For Vegetative Material

Bark smooth on mature trunks.
- Trunk and larger branches with projecting ridges; tree ..... 1. *Carpinus*

Trunk and larger branches without projecting ridges; shrub ..... 3. *Corylus*

Bark scaly on mature trunks.

Leaves in two rows, more or less in one plane.

Bark of mature trees with small, longitudinal shreds; some lateral veins forked; lenticels inconspicuous ..... 2. *Ostrya*

Bark of mature trees splitting into wide horizontal plates; lateral veins not forked; lenticels conspicuous ..... 4. *Betula*

Leaves in more than two rows ..... 5. *Alnus*

1. CARPINUS (Tourn.) L.

Usually small, slow-growing trees of the understory.

a. C. CAROLINIANA Walt. Blue Beech. Rich woods, stream banks and swamps. Found in all regions of Tennessee. The typical form is more common than the variety.

Var. VIRGINIANA (Marsh.) Fern. Differing from the typical form chiefly in the shape and serration of the leaves and fruiting bracts. Rich woods and stream banks in scattered locations in Tennessee, but most common in the Cumberland Mts., the Unakas, and on the bluffs of the Mississippi River.

2. OSTRYA (Mich.) Scop.

Usually slender trees, generally round-topped.

a. O. VIRGINIANA (Mill.) K. Koch. Hop-hornbeam. Rich woods, often on dry gravelly slopes and ridges. This species is often quite local, but present in nearly all regions of Tennessee. The typical form is found throughout the state with the exception of the southwest portion.

Var. LASIA Fern. Differing from the typical form by having the branches densely and subpersistently villous. Rich woods; a coastal plain variety which extends into western and southern portions of Tennessee.

3. CORYLUS (Tourn.) L.

Shrub or small tree four to eight feet high.

Fruiting involucre broad, foliaceous, incised; twigs and petioles glandular-bristly; leaves round-caudate .. a. *C. americana*

Fruiting involucre prolonged into a narrow beak; twigs without glands except near nodes; leaves ovate to ovate-oblong ..... b. *C. cornuta*

a. C. AMERICANA Walt. American Hazelnut. Thickets, clearings, and borders of woods throughout Tennessee in all regions. Tennessee is also in the range of var. *indehiscens* Palmer & Steyerm.; however, this has not been identified among the populations. This variety is distinguished by the involucre with bracts united to the summit on one side, or rarely on both sides.

b. C. CORNUTA Marsh. (*C. rostrata* Ait.). Beaked Hazelnut. Thickets and woods in only scattered locations in Tennessee.

4. BETULA (Tourn.) L.

Shrubs and trees of the Northern Hemisphere.

Twigs aromatic; leaves ovate to ovate-oblong; strobiles oblong-ovoid, nearly sessile.

Buds sharply pointed, mostly glabrous; bark of young trees tight, of mature trees broken into large, dark and irregular but not papery plates; scales of the pistillate catkins glabrous with broad divergent rounded or acute lateral lobes . . a. *B. lenta*

Buds acute, not sharp pointed, often pubescent; bark of the young trees peeling, of mature trees yellowish to silvery, peeling into papery plates; scales of the pistillate catkins often pubescent, ciliate on the margins, wedge-shaped with three regular to irregular lobes at the apex . . . . . b. *B. lutea*

Twigs not aromatic; leaves rhombic-ovate; strobiles cylindrical, borne on long slender peduncles . . . . . c. *B. nigra*

a. B. LENTA L. Sweet Birch. Rich woods on the Cumberland Mountains and at an elevation of 1700-4500 feet in the Great Smoky Mountains where it reaches its largest size (circumference 10 feet 10 inches at 4½ feet from base).

b. B. LUTEA Michx. f. (*B. allegheniensis* Britt., *B. lueta alleghcniensis* Ashe). Yellow Birch. Rich woods on the Cumberland Mountains and in the Great Smoky Mountains at an elevation of 1500-6300 feet. This is a characteristic associate of hemlock in many localities. The record size for this species is also from the National Park (circumference 14 feet 1 inch at 4½ feet from base).

The forma *fallax* as described by Fassett, has not been distinguished among the populations in Tennessee. It is quite possible that this tight-bark form is present, for the bark characteristics of *B. lenta* and *B. lutea* seem to intergrade.

Var. MACROLEPIS Fern. is the long extreme in bract length of the pistillate flower. This variety has been found (Fernald, 1922) in Blount and Carter Counties.

The taxonomy of the yellow birch has been confused for many years. In 1904, Dr. N. L. Britton described the form with the short scale as *B. allegheniensis*, and retained the long form as *B. lutea*. Ashe in 1918 reduced *B. allegheniensis* Britt. to a variety of *B. lutea*. Fernald (1922) has recognized *B. lutea* Michx. f. as the short-scaled form and described *B. lutea* var. *macrolepis* as the long-scaled form.

c. B. NIGRA L. River Birch. Moist woods, bottomlands and borders of rivers and streams throughout the state, but conspicuously absent from the Central Basin. It is found in the moist coves of the Unakas to an elevation of 3000 feet.

Betula papyrifera var. *cordifolia* (Reg.) Fern. Mountain Paper Birch. This variety has been reported by Shanks and Sharp (1950) as an introduced species in the Great Smoky Mountains, but there is no evidence that it is native in Tennessee. This variety has been found in West Virginia and above 5500 ft. on the Blue Ridge Mountains of North Carolina around Mt. Mitchell. These two stations are the southern extremes in range for this northern species.

5. ALNUS L.

Small, low shrubs or trees in the Northern Hemisphere and western South America.

Flowers developed with the expanding leaves; overwintering buds sessile; leaves irregularly serrulate or biserrulate with very fine and sharp crowded teeth; round-oval; ovate or slightly cordate ..... a. *A. crispa*

Flowers developed long before the expanding leaves; overwintering buds stipitate; leaves mostly simple serrate with short teeth often rather widely separated; obovate to obovate-elliptic, cuneate to slightly rounded at base ..... b. *A. serrulata*

a. A. CRISPA (Ait.) Pursh (*A. Alnobetula* (Ehrh.) K. Koch). Mountain Alder. This species is found in Tennessee only on Roan Mountain, Carter Co. It occurs here from 5000-6000 ft. on the altitude range of the Spruce-Fir forest, often forming shrub-balds much as the heaths.

Var. MOLLIS Fern. is the pubescent form and is found with the typical species on Roan Mountain.

b. A. SERRULATA (Ait.) Willd. Common Alder. Swamps, wet

woods, stream-margins, low fields in nearly all localities throughout Tennessee.

Forma NOVEBORACENSIS (Britt.) Fern. is the pubescent form and is more common than the typical species in the Tennessee populations.

Var. SUBELLIPTICA Fern. differs from the typical species in having the leaves broadly elliptic-obovate or sub-rotund.

Forma MOLLESCENS Fern. is the pubescent form of the above variety. This variety and its form are present in the Tennessee populations in only scattered locations.

There has been for many years confusion in the taxonomy of these species. The obovate-leafed form which is common in Tennessee and the south in general, long passed correctly as *A. serrulata* (Ait.) Willd., but especially since Karl Koch in 1872, John Coulter in 1894, and Sargent's Silva in 1896, it has been incorrectly passing as *A. rugosa* (Du Roi) Spreng. Almost from this start, these two species have been hopelessly confused. *Alnus rugosa* (Du Roi) Spreng. is a species of more northern range, the southern limit extending into West Virginia. It is recognized by its ovate, oval, round leaves broadest at or below the middle.

The name *Alnus incana* (L.) Moench, has been used incorrectly for many years for *A. rugosa* (Du Roi) Spreng. and *A. serrulata* var. *subelliptica* Fern. in this region. *Alnus incana* (L.) Moench is a European form which has been often cultivated in this country, and may sometimes escape from cultivation. This species does not come into the natural Tennessee populations at all, and is not known to be cultivated in the state.

Geographic Distribution

Tennessee is located within the wide range of many species of the Juglandaceae and Corylaceae, and thus their distribution is found to be throughout the state. Such species are *Juglans cinerea, Juglans nigra, Carya cordiformis, Carya ovata* and its var. *pubescens, Carya tomentosa, Carya glabra, Carya ovalis, Carpinus caroliniana* and its var. *virginiana, Ostrya virginiana* and its var. *lasia, Corylus americana, Betula nigra,* and *Alnus serrulata* and its var. *subelliptica.*

In a few cases the range of a species includes only a limited part of Tennessee. This is exemplified by *Carya aquatica* and *Carya illinoensis.* In these cases the ranges of the species are mostly south of Tennessee, but they extend up the Mississippi Valley into Tennessee naturally only on the Mississippi Flood Plains and tributary bottomlands and to a limited extent on the adjacent uplands. *Carya laciniosa*

is typically a more northcentral species, its distribution as mapped by Little (1949) crossing Tennessee through the northwestern half of the state. However, this species has been found locally throughout the state east to Monroe and Sevier counties.

Three species with a wider range in the north extend down the Appalachian Mountain Range into eastern Tennessee. *Betula lenta* and *Betula lutea* are thus found in this state only on the Unaka Range, the Cumberland Mountains and Walden Ridge of the Cumberland Plateau, and on the higher ridges of the Appalachian Valley Province. *Alnus crispa*, typically a species of the north, is found in western North Carolina and eastern Tennessee only at a high elevation on Roan Mt. This represents a southern outlying station from its continuous range of distribution.

Corylus cornuta has a fairly wide range in eastern North America, but is found rather rarely in Tennessee. Records are from Hawkins, Cocke, Claiborne, Polk, Rhea, and Marion counties with an outlying station in Obion county.

Limited to the southern states, *Carya carolinae-septentrionalis* is characteristic of limestone ridges, river-bottoms and low woods in Tennessee. This species has been recorded from every physiographic region of the state with the exception of the Mississippi Flood Plains and the Unaka Range; however, it is not abundant in any locality.

Carya pallida, which is a coastal Plain species, comes into Tennessee on the Cumberland Plateau, Highland Rim, and the uplands of west Tennessee. *Carya texana*, which might be expected to occur in rocky woods of the western and southwestern parts of the state, has been found thus far only in two locations of western Tennessee. This represents an eastern extension of its natural south-central range.

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THE UNIVERSITY OF GEORGIA

ATHENS

Notes on Woody Plant Distribution in Tennessee[1]

ROYAL E. SHANKS

Extensive field work and research on the vascular flora of Tennessee since 1947, sponsored by the Botany Department of The University of Tennessee and under the direction of Dr. A. J. Sharp and the writer, have made possible the preparation of rather complete spot distribution maps for all woody species. The compilation of these data into a preliminary check list (Shanks, 1952) has called attention to a number of unpublished extensions of known range, and has added detail to certain poorly understood distribution patterns. It is the purpose of the present paper to make these additional data available to students of the geography of woody plants.

Scientific names correspond with those used in *Gray's Manual of Botany, Eighth Edition* (Fernald, 1950). Distributions are summarized by counties and physiographic regions (Fenneman, 1938). The term *Unakas* is employed in the broad sense to include The Great Smoky Mountains and other ranges which constitute the western edge of the Blue Ridge Province and define the eastern border of Tennessee. Supporting specimens have been seen and at least part of them are in the herbarium of The University of Tennessee in every case not otherwise noted. The numerical order of the list is that of the Dalla Torre and Harms Index.

22. PINUS TAEDA L. Loblolly Pine. E. Tenn.: Meigs, McMinn, Hamilton, Bradley, Polk; m. Tenn.: Coffee, Giles, Lincoln, Franklin; w. Tenn.: Fayette, Hardeman, McNairy, Hardin.

27. TSUGA CAROLINIANA Engelm. Carolina Hemlock. Carter: along Laurel Fork Creek at about 2700 feet, the only known Tennessee station.

42. THUJA OCCIDENTALIS L. Arbor Vitae, White Cedar. Limestone bluffs along streams in upper Tenn. drainage: Sullivan, Washington, Hancock, Campbell, Anderson, Roane; southern limit of native distribution believed to be on bluffs of Emory River near Harriman, Roane County.

1872. POPULUS GRANDIDENTATA Michx. Bigtooth Aspen. Native: Stewart, Dickson; also recorded as a probable escape in Campbell, Sevier, and Unicoi.

POPULUS HETEROPHYLLA L. Swamp Cottonwood. Local in w.

[1]Contribution from the Botanical Laboratory, The University of Tennessee, N. Ser. 131.

Tenn. bottomlands: Obion, Weakley, Dyer, Lake, Gibson, Haywood; also Montgomery, Robertson.

1882. CARYA AQUATICA (Michx. f.) Nutt. Bitter Pecan, Water Hickory. Bottomlands, w. Tenn.: Shelby, Tipton, Lauderdale, Obion, Haywood, Crockett, Gibson.

CARYA CAROLINAE-SEPTENTRIONALIS (Ashe) Engl. & Graebn. Carolina Hickory. Widely distributed in every major region of the state except the Unakas and Cumberlands; known from twenty-eight counties n. w. to Sumner, Dickson, Benton, Gibson, Shelby.

CARYA LACINIOSA (Michx. f.) Loud. Big Shellbark Hickory. Bottomlands and local along streams in w. Tenn. and m. Tenn.; also very local in e. Tenn.: McMinn, Knox, Sevier, Grainger, Jefferson.

CARYA PALLIDA (Ashe) Engl. & Graebn. Sand Hickory. Cumberlands and e. Highland Rim; w. Rim and uplands of w. Tenn.; also Blount, Hawkins, Union.

CARYA TEXANA Buckl. (incl. var. *arkansana* Sarg. and *C. buckleyi* Sarg.) Black Hickory. Rare and local in w. Tenn.: Shelby, Henry.

1886. CORYLUS CORNUTA Marsh. Beaked Hazelnut. Rare and local: Rhea, Marion, Claiborne, Hawkins, Obion, Polk.

1887. *Betula papyrifera* var. *cordifolia* (Regel) Fern. Paper Birch. No evidence that this species is native in Tennessee; earlier reports evidently based on specimens persisting after cultivation.

1893. QUERCUS BICOLOR Willd. Swamp White Oak. Rare and local: Hardeman, Humphreys, Robertson, Bedford, Cumberland, Sevier.

QUERCUS LAURIFOLIA Michx. Laurel Oak. Franklin, where known from a single station along the Elk River.

QUERCUS LYRATA Walt. Overcup Oak. Common in bottomlands of w. Tenn. but very local eastward: Montgomery, Robertson, Davidson, Lawrence, White.

QUERCUS MACROCARPA Michx. Bur Oak. Local in m. Tenn.: Stewart, Montgomery, Cheatham, Davidson, Wilson, Williamson, Rutherford, Maury, Bedford; also Lake, Dyer, Obion.

QUERCUS MICHAUXII Nutt. Swamp Chestnut Oak. General in w. Tenn., elsewhere local; m. Tenn.: Stewart, Montgomery, Moore; e. Tenn.: Hamilton, Bradley, Union, Grainger.

QUERCUS NIGRA L. Water Oak. General and common in w. Tenn.; also Wayne, Lawrence, Lincoln, Franklin, Marion, Hamilton, Coffee, Grundy.

QUERCUS PRINOIDES Willd. Scrub Chestnut Oak. Davidson, Wilson, Knox. (Michaux, 1805).

QUERCUS SHUMARDII Buckl. Shumard Red Oak. Frequent in the Central Basin and Highland Rim; infrequent in e. Tenn., as far e. as Claiborne, Grainger, Jefferson; infrequent but at widely scattered stations in w. Tenn.

QUERCUS SHUMARDII var. SCHNECKII (Britt.) Sarg. Schneck Red Oak. Apparently much less common than the typical form: Shelby, Montgomery, Davidson, Williamson, Humphreys, Lincoln, Knox, Hamilton (Sargent).

1896. ULMUS CRASSIFOLIA Nutt. Cedar Elm. Shelby, on the bluffs above the Mississippi Alluvial Plain; a northward extension of the published range.

ULMUS SEROTINA Sarg. September Elm. Limestone outcrops of Central Basin and Highland Rim: sixteen counties from Houston, Perry, Wayne to Jackson, DeKalb, Bedford; also Jefferson.

1897. PLANERA AQUATICA (Walt.) Gmelin. Planer Tree, Water Elm. W. Tenn. bottomlands: ten counties e. to Weakley, Gibson, Hardeman; also Decatur, Hardin.

2109. BUCKLEYA DISTICHOPHYLLA Torr. Sapsuck. Sullivan, Washington, Unicoi, Greene, Cocke.

2566. BERBERIS CANADENSIS Mill. Barberry. Sullivan, Morgan.

2651. MAGNOLIA MACROPHYLLA Michx. Large-leaf Magnolia, Wahoo. Rather general in Cumberlands: twelve counties; also Sevier, Cocke, Hardin, Wayne, Lawrence, Marshall.

MAGNOLIA VIRGINIANA L. Sweet Bay. Rare and local: Shelby, McNairy, Polk.

2656. SCHISANDRA GLABRA (Brickell) Rehd. Scarlet Woodbine. W. Tenn.: Shelby, Tipton.

2798. LITSEA AESTIVALIS (L.) Fern. Pond Spice. Listed for Tenn. by Small and Fernald without locality, by Gattinger from "Swamps on Cumberland Mts."; no Tennessee specimens seen.

3217. HYDRANGEA QUERCIFOLIA Bartr. Oak-leaf Hydrangea. S. edge of Tenn.: Shelby, McNairy, Hardin, Wayne, Lawrence, Lincoln, Coffee, Franklin, Marion.

3222. DECUMARIA BARBARA L. Climbing Hydrangea. Rather widely distributed in w. Tenn.; also Wayne, Lincoln, Polk.

3231. ITEA VIRGINICA L. Principal Tenn. range in fourteen counties centering in s. Cumberlands and extending w. to Coffee and

Lincoln; also w. Tenn.: Henderson, Hardeman, McNairy, Chester, Carroll, Benton; m. Tenn.: Robertson, Lewis; e. Tenn.: Blount.

3249. RIBES CURVATUM Small. VanBuren, Bledsoe, Rhea, Hamilton.

Ribes lacustre (Pers.) Poir. Unknown from Tennessee; the manual reports based on an early error in identification.

3302. FOTHERGILLA GARDENI Murr. Witch Alder. Blount, Sevier, Grainger.

3319. SPIRAEA ALBA DuRoi. Meadowsweet. Johnson, where known only from Shady Valley bog.

Spiraea japonica var. *fortunei* (Planch.) Rehd. Pink Spiraea. Escaped in Cumberlands: Scott, Cumberland, Morgan, Grundy, Franklin (Svenson).

SPIRAEA VIRGINIANA Britt. Virginia Spiraea. Blount, a single station for the state (specimens in U. S. National Herbarium and Gray Herbarium).

3344. AMELANCHIER HUMILIS Wiegand. Dwarf Serviceberry. The dwarf stoloniferous shrub of Cumberland and Bledsoe apparently represents undescribed variation within this species.

3396. PRUNUS MEXICANA Wats. Big-tree Plum. Obion, Dyer, Shelby.

PRUNUS SUSQUEHANAE Willd. Dwarf Cherry. Coffee, where known from two stations in the barrens.

3544. GLEDITSIA AQUATICA Marsh. Water Locust. W. Tenn. bottomlands: Lake, Obion, Dyer, Lauderdale, Shelby.

3545. GYMNOCLADUS DIOICA (L.) K. Koch. Kentucky Coffee Tree. Rare and local on limestone bluffs in m. Tenn.; w. Tenn.: Obion, Dyer, Lauderdale, Shelby, Hardin; single stations in Cumberland, Knox, Anderson.

3606. CLADRASTIS LUTEA (Michx. f.) K. Koch. Yellow-wood. Every major region but usually extremely local; w. Tenn.: Dyer, Shelby; Central Basin: Cheatham, Davidson; e. Highland Rim and adjacent Cumberland Plateau: Franklin, Grundy, Warren, White, Van Buren, Bledsoe; e. Tenn.: Anderson, Knox, Sevier.

4069. PTELEA TRIFOLIATA L. Hop Tree. Infrequent, principally on limestone outcrops in m. Tenn. e. to White, w. to Decatur and Hardin.

4585. COTINUS OBOVATUS Raf. Smoke Tree. Franklin only, from the slope at the western edge of the Cumberland Plateau.

4594. RHUS VERNIX L. Poison Sumac. Rare and local in n.e. corner of Tenn.: Johnson, Carter; also in s. Cumberlands: Grundy, Franklin, Marion.

4614. ILEX LONGIPES Chapm. Long-stalked Holly. Wayne, Lewis, Franklin, Hamilton.

ILEX MONTANA T. & G. in Gray. Mountain Holly. E. Tenn.: Sixteen counties w. to VanBuren, Franklin; also Hardin, along Tennessee River.

4720. ACER LEUCODERME Small. Chalk Maple, Whitebark Maple. Polk, along the Ocoee River; a series of specimens distributed by the Biltmore Herbarium (specimen seen at Missouri Botanical Garden).

4868. BERCHEMIA SCANDENS (Hill) K. Koch. Rattan-vine. Bottomlands of w. Tenn.; s. part of m. Tenn. n. to Rutherford; also Decatur, Rhea.

4875. RHAMNUS ALNIFOLIA L'Her. Alder-leaf Buckthorn. Campbell, station now covered by waters of Norris Lake.

RHAMNUS LANCEOLATA var. GLABRATA Gleason. Lanceleaf Buckthorn. Rutherford, in the cedar glades.

5152. STEWARTIA OVATA (Cav.) Weatherby. Mountain Camellia. Great Smoky Mts.: Blount, Sevier; Cumberlands: Campbell, Anderson, and Union w. to Pickett, VanBuren, Grundy, Franklin.

5167. ASCYRUM STANS Michx. St. Peter's-wort. Rather general in Cumberlands from Fentress and Morgan to Hamilton and Grundy; also Coffee.

6184. RHODODENDRON CAROLINIANUM Rehd. Carolina Rhododendron. Unakas and adjacent territory: Blount, Sevier, Cocke, Carter, Unicoi; some material previously referred to *R. minus* Michx. (*R. punctatum* Andr.) cannot be satisfactorily distinguished from this species and is included here.

RHODODENDRON CATAWBIENSE Michx. Purple Rhododendron. Unakas: Blount, Sevier, Cocke, Unicoi, Carter; also Grainger, Fentress.

RHODENDRON CUMBERLANDENSE Braun. Late Red Azalea. Cumberland Plateau: Grundy, Van Buren, Cumberland.

6192. KALMIA ANGUSTIFOLIA var. CAROLINIANA (Small) Fern. Lambkill. Johnson, where known only from Shady Valley bog.

6198. LEUCOTHOE RECURVA (Buckl.) Gray. Unakas and adjacent counties: Sevier, Cocke, Unicoi, Carter, Johnson, Washington, Sullivan.

6200. LYONIA LIGUSTRINA var. SALICIFOLIA (Wats.) DC. Lincoln, Carroll.

LYONIA MARIANA (L.) D. Don. Staggerbush. Coffee (Svenson); also listed by Fernald for w. Tenn.; no specimens seen.

6215. GAYLUSSACIA BRACHYCERA (Michx.) Gray. Box Huckleberry. N. Cumberland Plateau where locally abundant: Pickett, Fentress, Scott; also Polk (Gattinger).

GAYLUSSACIA DUMOSA (Andr.) T. & G. Dwarf Huckleberry. Coffee, at several stations in the barrens.

6216. VACCINIUM ERYTHROCARPUM Michx. Mountain Cranberry. Unakas: Blount, Sevier, Unicoi, Carter; also Grundy, Rhea; our material is mostly the forma *nigrum* Allard.

VACCINIUM HIRSUTUM Buckl. Hairy Blueberry. Bledsoe, Rhea, Polk, Monroe, Blount.

VACCINIUM MACROCARPON Ait. Cranberry. Johnson, where known from three bogs.

6406. DIOSPYROS VIRGINIANA var. PUBESCENS (Pursh) Dippel. The characteristic persimmon of the w. Tenn. swamps and adjacent uplands: Obion, Henry, Dyer, Lauderdale, Haywood, Madison, Chester.

6410. HALESIA CAROLINA L. (incl. *H. monticola* (Rehd.) Sarg.) Silverbell. Unakas: Blount, Sevier, Cocke, Unicoi; also Knox, Washington, Marion, Hamilton; w. Tenn.: Decatur, Hardin. While the mountain populations have the greater size of *H. monticola*, other supposed morphological distinctions do not appear to be constant and the broader species concept is here retained.

6411. STYRAX AMERICANA Lam. Storax. W. Tenn.: Dyer, Tipton, Shelby, Haywood.

STYRAX GRANDIFOLIA Ait. Large-leaf Storax. W. Highland Rim: Stewart, Houston, Humphreys, Perry, Dickson, Hickman, Wayne.

6418. SYMPLOCOS TINCTORIA (L.) L'Her. Sweetleaf, Horse Sugar. Polk, where known from a single station.

6427. FORESTIERA ACUMINATA (Michx.) Poir. Swamp Privet. Along stream banks and in river swamps, w. and m. Tenn. as far e. as White.

FORESTIERA LIGUSTRINA Poir. Limestone cedar barrens of Central Basin: Davidson, Rutherford; also Franklin, Lincoln.

6447. GELSEMIUM SEMPERVIRENS (L.) Ait. f. Yellow Jessamine. Hamilton, Rhea.

6667. TRACHELOSPERMUM DIFFORME (Walt.) Gray. Climbing Dogbane. General in w. Tenn. bottoms as far e. as Weakley, Henderson, Chester.

7308. CONRADINA VERTICILLATA Jennison. Rosemary. Rare endemic restricted to the n. Cumberland Plateau: Fentress, Morgan, Scott and one adjacent county in Kentucky (McCreary).

7727. CATALPA SPECIOSA Warder. Catalpa. Native in w. Tenn., attaining near-record size in Fayette Co., with circumference of 14 ft., 9 in.; widely naturalized in every region, obscuring its natural range; fewest records from the Cumberlands.

8516. VIBURNUM NUDUM L. Possumhaw Viburnum. W. Tenn.: Henry, Carroll, Chester, Hardeman, McNairy; also e. Highland Rim and adjacent edge of Cumberland Plateau: Warren, Grundy, Franklin.

8523. LONICERA CANADENSIS Bartr. American Fly Honeysuckle. Great Smoky Mts.: Sevier.

8524. DIERVILLA LONICERA Mill. (*D. trifida* Moench). Bush Honeysuckle. Hamilton, Cheatham.

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THE UNIVERSITY OF TENNESSEE
KNOXVILLE

Periodic Precipitation Affects Growth of Yellowpoplar on a West Virginia Hillside *

E. H. Tryon and C. A. Myers

Introduction

A stand of yellowpoplar (*Liriodendron tulipifera L.*), in which frost damage has been found in many of the trees, was investigated during the winter and spring of 1950 in order to learn more about the injury. During this investigation it was observed that a narrow growth ring had formed the year following the injury. Yellowpoplars on the same area that had not been injured by frost also produced a narrow growth ring during the same period, indicating that the narrow ring was caused by a factor or factors other than frost. More careful observation disclosed a consistent pattern of ring widths which was particularly pronounced during the period 1933 to 1936 because of the narrow 1934 and 1936 annual rings. Since the amount of precipitation during certain periods of the year has been directly associated with annual diameter growth of trees in several sections of the country, it seemed possible that the pattern of ring widths observed could be explained, at least in part, by the amount of precipitation received locally during some period of the year. A study was made to determine whether or not amount of precipitation is related to radial growth-rate of yellowpoplar on the area studied, and if such a relationship exists, to determine the portion of the year contributing precipitation which has the greatest influence on such growth-rate.

Description of the Area

The area studied is three acres in size and is three miles northeast of Morgantown, West Virginia. The area lies at an elevation of 1,100 feet whereas the elevation of Morgantown is 900 feet. Precipitation is quite evenly distributed throughout the year. Morgantown has had an average of 40.61 inches of precipitation annually during the past 40 years with monthly averages as low as 2.48 inches for November and as high as 4.25 inches for June during the same

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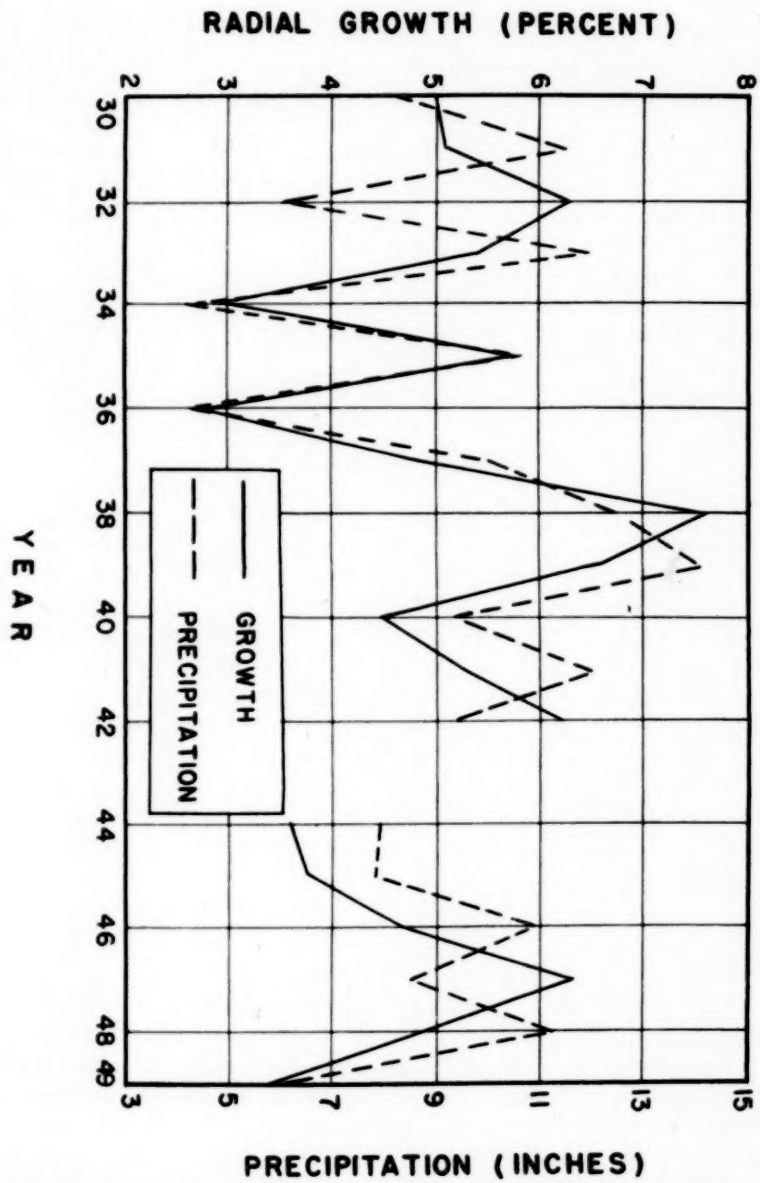

Figure 1: Comparison of average radial growth of yellowpoplars with precipitation for the period May 1 to June 30.
(basis: 9 trees)

period (10). However, wide departures from the average are not uncommon. During the period 1929 to 1949, considered for this study, annual precipitation varied from 25.15 inches to 53.46 inches. June precipitation during the same period ranged from 2.04 inches to 13.36 inches (11). Snow contributes a small percentage of the total annual precipitation and does not remain on the ground except during short periods of low temperature.

The area investigated has a northwest aspect with a 30 per cent slope. The underlying strata are largely shales with interbedded sandstones and are immediately below the Pittsburgh coal seam. The soil derived from these shales and sandstones is a Gilpin loam. The A and B horizons together average about one foot in depth. The depth of the C horizon is variable, borings showing it to be from one foot to over three feet in depth. The soil is rather coarse throughout most of the area and indications are that drainage, particularly through the C horizon, is excellent.

Thirty-year-old yellowpoplars are the most numerous component of the overstory with an understory of mixed hardwoods typical of the region. The quality of the site is better than average for yellowpoplar.

Methods

Yellowpoplars in the dominant and co-dominant crown-classes were the only trees examined. Those showing external or internal injuries such as a broken top or frost damage within the bole were not included nor were those showing a period of suppression during any portion of their life. A total of only nine trees were used in the study.

Paired cores, extending to the center, were taken with an increment borer from the north and south sides of each tree at breast height. The cores were immediately placed in oil and allowed to soak. The cores, made more translucent by the oil, were placed on the mechanical stage of a 13-power binocular scope. By transmitting light through the core, the growth rings could be determined readily, and by moving the core past a mark in the ocular, the width of the rings could be measured to the nearest tenth of a millimeter on the stage vernier. Since the trees were only 30 years of age, a 20-year period, from 1930 to 1949 was selected for the study. The radial growth for each year was expressed as a percentage of the total for the 20-year period.

Precipitation-data were obtained from the weather station in Morgantown. Several of the monthly records during and near 1943 were missing, and this resulted in a break in the 1930 to 1949 sequence since no attempt was made to compute the missing values.

In order to compare radial growth of the nine sample trees with precipitation, many different periods of precipitation were tested. The first periods tested were ones that other investigators throughout the United States have found to be closely associated with radial growth of trees. Other precipitation periods, close to or within the limits of the one showing the best relationship, also were tested. The relationship of growth to precipitation for the periods chosen was tested by the correlation coefficient (8) since a linear trend existed.

Results and Conclusions

The results of the investigation are given in Table 1. Precipitation periods involving summer months were the only ones showing a significant relationship between precipitation and radial growth as tested by the correlation coefficient. The best relationships obtained are for periods which closely correspond to or are within the growing season of yellowpoplar which is approximately from May 1 to August 15, locally.

Results indicate a better relationship between radial growth and precipitation during May 1 to June 30, the early portion of the growing season, than for the period most nearly covering the entire growing season, May 1 to August 31. The coefficient of the first is 0.675 and that of the latter 0.559. Such a relationship seems reasonable since the greatest amount of annual wood is laid on during May and June.

Figure 1 shows graphically the nature of the relationship involved. Average yearly radial growth of the trees and the precipitation for the period May 1 to June 30 inclusive for the years 1930 to 1949 are shown. However, data for 1943 have been omitted because of incomplete precipitation records.

Other workers throughout the eastern United States also have found for certain areas that precipitation during or within the growing season is related to annual radial growth of certain forest species. References 1 to 7 inclusive and 9 report a total of eight species in seven eastern states, from Vermont to Florida, in which a relationship has been found between tree ring growth and precipitation during summer months.

Table 1. Relationship between radial growth of yellowpoplar and precipitation for selected periods (basis: 9 trees)

Period (dates inclusive)	Correlation Coefficient	Significance
Sept. 1 to May 31	0.063	None
Dec. 1 to Aug. 31	0.157	None
Present and previous		
May 1 to Aug. 31	0.309	None
June 1 to July 31	0.456	None
March 1 to Aug. 31	0.290	None
June 1 to Aug. 31	0.433	None
April 1 to Aug. 31	0.444	None
May 1 to July 31	0.616	HS
May 1 to June 30	0.675	HS
May 1 to Aug. 31	0.559	Sig

Sig, significant at the 5% level. HS, significant at the 1% level.

While suppressed yellowpoplars were not used for this study, it was noted that they exhibited the same ring-growth pattern as individuals of better crown class.

Borings of red oak (*Quercus borealis* Michx. f.), chestnut oak (*Q. montana* Willd.), black oak (*Q. velutina* La Marck), and red maple (*Acer rubrum* L.), in the stand were examined to see if these species showed a distinct pattern in annual ring widths as did yellowpoplar. The growth rings showed no apparent correlation with precipitation, perhaps indicating that these species are less sensitive to low soil moisture than the yellowpoplar.

Yellowpoplars on this area had narrow annual rings when summer precipitation was low. Other areas in this vicinity where yellowpoplar occurs have been observed, and although precipitation has been approximately the same, most of them do not show apparent differences in ring width resulting from low precipitation. Where differences have been observed, a steep slope indicating excellent drainage conditions has been evident. The reason for sensitivity to precipitation of the radial growth of yellowpoplars on the area studied is evidently lowered soil moisture when summer precipitation is low. The coarse C horizon of the soil combined with the slope of the ground result in excellent drainage conditions which carry water rapidly from

the area. Thus low summer rainfall may not be able to keep soil moisture at a desirable level for satisfactory annual radial growth of yellowpoplar and the result is the production of a narrow growth ring when precipitation, and resulting soil moisture, is low.

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DIVISION OF FORESTRY

WEST VIRGINIA UNIVERSITY

MORGANTOWN

NOTES and NEWS

REPORT ON PRESERVATION OF TREE TWIGS IN POLYETHYLENE BAGS—The preservation of fresh tree and shrub twigs for study in Systematic Botany is usually a problem confronting teachers, when no refrigeration is available. Twigs brought into dry, heated, buildings in the winter, tend to wrinkle so severely from drying that identification is difficult or impossible, especially on smaller twigs. The writer, in attempting to find a solution to this problem, investigated the possibility of using polyethylene bags designed for disposable baby bottles. These are obtainable in roll form, with each 4 or 8 ounce bottle removed from the roll with scissors, and the open end can be sealed quite effectively by the use of a rubber band. The 8 oz. bags are 2 inches in diameter, and 6½ inches long, while the 4 oz. bags are approximately half this length.

Fresh twigs are placed in the bags, which are then sealed with rubber bands, and labelled with a strip of paper and cellulose tape. This method was used in an informal experiment, in which the twigs in bags were kept in a normally heated room, under no refrigeration, for the lack of refrigeration is one of the reasons they cannot be kept more easily without bags. The following results were obtained on twigs kept as above for a period of three months:

NO DECAY	*SOME DECAY*	*BADLY DECAYED*
Amelanchier arborea	Acer nigrum	Tilia americana
Lindera Benzoin	A. rubrum	Aesculus octandra
Hamamelis virginiana	A. saccharum	Asimina triloba
Juglans nigra	Ulmus americana	Alnus serrulata
Corylus americana	Quercus borealis	Ulmus fulva
Carpinus caroliniana	Q. imbricaria	
Fraxinus americana	Q. stellata	
F. pennsylvanica	Q. velutina	
Platanus occidentalis	Prunus serotina	
	Fagus grandifolia	

The ratings are given as amounts of decay because this was the earliest defect showing any damage to the twigs, as the bags rather

effectively retarded evaporation and consequent withering.

Several of these same species were treated in the above manner, but were kept under 38° F. refrigeration for the three month period. All were practically perfect at the end of the period, and the writer believes many common species would be identically preserved. Most diseases (fungi, etc.) contained in the twigs would be inhibited by refrigeration, consequently withering would be the major defect, and it would be retarded by the lack of evaporation.

Twigs up to 41/2 inches in length can be placed in the 8 oz. bag, the cost of which is approximately 11/2 cents per bag. It is thought that these bags might be used for many purposes where a tough, flexible, waterproof bag is needed.—Jesse F. Clovis, West Virginia University.

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